

PERFORMANCE SPECIFICATION

ULTRAFILTRATION SYSTEM, 50-GALLON PER MINUTE
OILY WASTE MEMBRANE (OWMS-50)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a fully automated and self-contained oily waste membrane system (OWMS) capable of providing secondary treatment of the effluent (see 6.7.4) from 50-gallon per minute (gpm) oil/water separators (OWS) (see 6.7.8) in Naval shipboard installations. The effluent will contain no more than 15 parts per million (ppm) oil.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-680	-	Degreasing Solvent
MIL-S-901	-	Shock Tests H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

MIL-PRF-32041

MIL-DTL-5624	-	Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST
MIL-PRF-9000	-	Lubricating Oil, Shipboard Internal Combustion Engine, High Output Diesel
MIL-D-16791	-	Detergents, General Purpose (Liquid, Nonionic)
MIL-PRF-16884	-	Fuel, Navy Distillate
MIL-PRF-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service
MIL-F-24385	-	Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater
MIL-DTL-24643	-	Cables and Cords, Electric, Low Smoke, for Shipboard Use, General Specification for
MIL-PRF-32097	-	Filtration Module, Oily Waste Membrane Type

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-167/1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-740/1	-	Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-740/2	-	Structureborne Vibratory Acceleration Measurements Acceptance Criteria of Shipboard Equipment
MIL-STD-777	-	Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1310	-	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
MIL-STD-1399, Section 300	-	Interface Standard for Shipboard Systems, Section 300, Electric Power, Alternating Current (Metric)

MIL-STD-1553 - Digital Time Division Command/Response Multiplex Date Bus

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4/D, Philadelphia, PA 19111-5094 or <http://astimage.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 1664 - Guidelines Establishing Test Procedures for the Analysis of Oil and Grease and Non-Polar Material

(Applications for copies should be addressed to Environmental Protection Agency, National Technical Information Service 5285 Port Royal Road, Springfield, VA 22161 or www.epa.gov.)

DRAWINGS

NAVSEA DWG 803-6983497 - Membrane Module, Detail

(Copies of this drawing are available from Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013 - Reduced Pressure Principle Backflow Preventers

(Application for copies should be addressed to American Society of Sanitary Engineering, 901 Canterbury Road, Suite A, Westlake, Ohio 44145 or www.asse.org.)

ASTM International

ASTM F1155 - Standard Practice for Selection and Application of Piping System Materials

ASTM F1166 - Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428 or www.astm.org.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 45	-	IEEE Recommended Practice for Electric Installations on Shipboard
IEEE 1284	-	IEEE Standard Signaling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers
IEEE 1451.2	-	A Smart Transducer Interface for Sensors and Actuators - Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats

(Application for copies should be addressed to Institute of Electrical and Electronics Engineers, IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 or www.ieee.org.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	-	Enclosures for Electrical Equipment (1000 Volts Maximum)
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(Application for copies should be addressed to National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, VA 22209 or www.nema.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.1.1.

3.2 Material. The contractor shall select the materials, but the materials selected shall be capable of meeting all of the requirements specified herein. All materials shall be commercially available and conform to applicable commercial marine standards and practices. No toxic chemicals or hazardous substances shall be used.

3.2.1 Wetted materials. All materials in contact with the oily wastewater and/or processed byproducts shall be compatible, with no evidence of deleterious effect including membrane performance degradation, with the following: seawater; diesel fuel marine fuels specified in MIL-PRF-16884; turbine fuels specified in MIL-DTL-5624, 2190 TEP steam lube oil specified in MIL-PRF-17331, and 9250 diesel lube oil specified in MIL-PRF-9000; and contaminants such as bleach, acetone, paint thinner, degreasing solvent specified in MIL-PRF-680 (Type III), and aqueous film forming foam specified in MIL-F-24385. In addition, all materials in contact with the mixture recirculated through the membrane filtration modules shall be both erosion and corrosion resistant (e.g., glass reinforced plastic, titanium, etc.) and shall not degrade performance of the membranes.

3.2.2 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with each other unless protected against galvanic corrosion. Sacrificial anodes are not permitted.

3.2.3 Material deterioration, prevention and control. The OWMS-50 shall be fabricated from compatible materials, inherently resistant to or treated to provide protection against corrosion and

microbial deterioration for the system's service life and in any shipboard or storage environment specified herein.

3.2.4 Identification of materials and finishes. The contractor shall identify the specific material, material finish or treatment for use with component and subcomponent.

3.2.5 Electrical cable materials. All electrical cable materials shall meet the low smoke requirements of MIL-DTL-24643.

3.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Environmental considerations.

3.4.1 Shock. The module shall meet the requirements of Grade B, Class I, Type A shock in accordance with MIL-S-901.

3.4.2 Environmental vibration. The system shall meet the environmental Type I vibration requirements in MIL-STD-167/1.

3.4.3 Internally excited vibration. All OWMS-50's rotating machinery shall meet the Type II vibration requirements in MIL-STD-167/1.

3.4.4 Airborne noise. The OWMS-50 shall meet the requirements of airborne noise in MIL-STD-740/1 for Grade E equipment.

3.4.5 Structureborne noise. The OWMS-50 shall meet the requirements of generated structureborne noise in MIL-STD-740/2 for Type II equipment.

3.4.6 Electromagnetic interference. The OWMS-50 shall meet the electromagnetic emissions and susceptibility requirements in MIL-STD-461 for auxiliary equipment operating in a machinery space of the intended ship, or class of ship (see 6.2).

3.4.7 Operational temperatures. The OWMS-50 shall meet specified performance requirements when operating in an ambient air temperature environment range of 50 °F to 122 °F.

3.4.8 Storage (non-operating) temperatures. When in a non-operating state, the OWMS-50 shall not be damaged nor shall subsequent operational performance be degraded as a result of being subjected to ambient air temperatures ranging from -40 °F to 158 °F.

3.4.9 Humidity. The OWMS-50 shall not be damaged nor shall subsequent operational performance be degraded when subjected to the combined temperature and relative humidity profiles in MIL-STD-810, Method 507.4.

3.4.10 Inclination. The OWMS-50 shall operate as specified herein and prevent loss of fluid when inclined at the rate of 5 to 7 cycles per minute in one phase to angles of 15 degrees on both sides of the vertical for a period of not less than 30 minutes.

3.4.11 Salt fog. The OWMS-50 shall remain fully operational during and after a 48-hour exposure to salt fog as specified in MIL-STD-810, method 509.

3.5 Design. The OWMS-50 shall incorporate a feed system (see 6.7.5), a separation system using filtration modules, a potable water distribution system, and a control system including sensors. The OWMS-50 shall be a fully automatic and package-type (skid-mounted) unit ready for operation with the current ship's architecture (structure, mechanical, electrical, data). A pneumatic distribution system shall be required if the contractor design utilizes externally provided compressed air. Guidance for the OWMS-50 system design is provided in Section 6.

3.5.1 Feed system. The feed system shall provide the interface with the ship as specified in 3.7.1 and deliver oily wastewater feed into the separation system as required to support the requirements specified herein.

3.5.2 Separation system. The OWMS-50 separation system shall consist of fifteen membrane filtration modules conforming to MIL-PRF-32097 and the interface requirements of NAVSEA DWG 803-6983497, installed in a cross flow recirculation subsystem (see 6.7.13), and connected to a permeate discharge subsystem. The OWMS-50, with the filtration modules installed, shall maintain a 100-to-1 volume reduction factor (see 6.7.15) of the ship's OWS effluent. The filtration module interfaces shall be as specified in 3.7.2.

3.5.3 System connections. The OWMS-50 inlet and outlet ship interface connections shall consist of the following: ship's OWS effluent supply, permeate (see 6.7.11) discharge, concentrate (see 6.7.1) discharge, flushing water discharge, potable water inlet, and if necessary, a compressed air inlet. The OWMS-50 shall also be equipped with sampling ports to allow manual sampling of oily wastewater feed, permeate produced from each individual membrane filter module, and concentrated oil.

3.5.4 Size and weight. The OWMS-50 shall not exceed 102 inches high by 216 inches wide by 60 inches deep and a wet weight of 12,000 pounds when fully assembled.

3.5.5 Power consumption. The OWMS-50 power consumption shall not exceed 60 kilowatts (kW), with a current draw not to exceed 75 amps steady state.

3.5.6 Compressed air consumption. The OWMS-50 compressed air consumption shall not exceed 20 standard cubic feet per minute (scfm). The average air consumption shall not exceed 5 scfm.

3.5.7 Grounding and bonding. Grounding and bonding of the OWMS-50 electrical enclosure, pumps, and system frame to the ship's substructure shall be provided for electrical safety connection and an effective low-impedance RF connection as per MIL-STD-1310.

3.5.8 Markings. The OWMS-50 shall have permanently affixed and legible markings located on the front of the unit that identify the OWMS-50 manufacturer's name, model and serial number, national stock number (NSN), if specified (see 6.2). The electrical enclosure shall have permanently affixed markings that identify the manufacturer's name, model and serial number, voltage, frequency, and maximum horse power rating, and low noise, if applicable. All system piping shall be identified for its specific service (i.e., potable water, etc.), pressure and direction.

3.6 Performance characteristics. The OWMS-50 system shall automatically sense operation of the ship's OWS, receive the effluent from the ship's OWS, process it as feed, and generate permeate and concentrate. The OWMS-50 shall deliver permeate for overboard discharge through the permeate discharge interface connection, deliver concentrate for discharge to the ship's waste oil tank (WOT) (see 6.7.15) through the concentrate discharge interface connection, and back flush water through the flushing water discharge interface connection. Operation and control of OWMS-50 shall be as specified in 3.6.6. The OWMS-50 performance shall be compatible with the shipboard interfaces defined in 3.7.1 and filtration module interfaces defined in 3.7.2.

3.6.1 Permeate discharge requirements.

3.6.1.1 Permeate discharge flow. The OWMS-50 shall deliver permeate through the permeate discharge interface connection at a design flow rate of 50 gpm against a hydraulic resistance of 15 psi.

3.6.1.2 Oil removal. When operating at rated flow and pressure, the OWMS-50 shall deliver permeate water as specified in 3.6.1.1 containing no greater than 15-ppm free oil, as measured by EPA 1664, for 95% of the time from oily wastewater feed when tested as specified in 4.3.4.

3.6.2 Concentrate discharge requirements.

3.6.2.1 Concentrate discharge flow. The OWMS-50 shall deliver concentrate through the concentrate discharge connection at positive flow against a hydraulic resistance range of -3 to 22 psi.

3.6.2.2 Particulate removal. The OWMS-50 shall automatically remove particulates greater than 150 microns from the ship's OWS effluent. Accumulated particles shall be automatically purged and discharged through the concentrate discharge connection as specified in 3.6.2.1. This purge cycle shall be activated automatically upon system shutdown and/or when the solids retention capacity is reached. Discharges of solid waste shall contain less than 8 gallons of fluid per cycle.

3.6.3 Flushing water discharge requirements.

3.6.3.1 Flushing water discharge flow. The OWMS-50 shall deliver flushing water with residue through the flushing water discharge interface connection at positive flow against a hydraulic resistance range of -3 to 22 psi.

3.6.3.2 Self-cleaning cycles.

3.6.3.2.1 Membrane back flush cleaning cycle. The OWMS-50 shall conduct a back flush cleaning cycle of the filtration membranes as specified in MIL-PRF-32097, using no more than 200 gallons of ship-supplied potable water, discharging the back flush water as specified in 3.6.3.1. This cleaning cycle shall be activated automatically upon system shutdown and shall be capable of being manually activated.

3.6.3.2.2 Membrane hot flush cleaning cycle. The OWMS-50 shall be capable of conducting a 6-hour hot flush cleaning cycle of the filtration membranes, using no more than 750 gallons of ship-supplied potable water at a self-heated temperature between 120 °F and 150 °F (max) and within the thermal shock conditions defined in MIL-PRF-32097, discharging the back flush water as specified in 3.6.3.1. The OWMS-50 shall not be damaged nor shall subsequent operational performance be degraded as a result of being subjected to this procedure.

3.6.3.3 System drain. All OWMS-50 system drains shall be capable of draining through the OWMS-50 flushing water discharge interface connection as specified in 3.6.3.1. The time to drain secondary separation recirculation loop shall not exceed 60 minutes. Compressed air may be used to facilitate system dewatering, given appropriate safety precautions. Vendor must supply suitable hoses and pressure regulators.

3.6.4 Back flow prevention. The OWMS-50 shall prevent back flow of oily wastewater, potable water, and compressed air (if used) into their respective ship supply sources. The OWMS-50 shall also prevent permeate, flushing water and concentrate from backing up into their respective OWMS-50 discharge port. A reduced pressure principle sanitary back flow preventer conforming to ASSE 1013 shall be used to protect the ship's potable water from cross-contamination.

3.6.5 Compressed air moisture removal. If OWMS-50 utilizes dry compressed air, it shall be capable of automatically removing moisture from the supply air and discharging it to a ship-supplied bilge funnel.

3.6.6 Operation and controls. The OWMS-50 control system shall monitor and control operation, report status, activate warning indicators, and sound alarms for all OWMS-50 systems (i.e., separation, pneumatic, potable water, etc.). All OWMS-50 systems shall self-monitor their respective operating parameters (i.e., flow, pressure, etc.). The OWMS-50's control system shall interface with the ship's centralized control system (Integrated Condition Assessment System (ICAS)) to provide remote monitoring and condition assessment. Manual overrides shall be provided for troubleshooting purposes.

3.6.6.1 Normal operation. Once the system has been powered up and valve alignment has been completed, the OWMS-50 shall operate automatically, starting up when the system senses influent flow and automatically shutting down when there is no flow of influent for a period of 15 minutes. The OWMS-50 process rate shall equal the OWS effluent flow rate. Influent flow exceeding the OWMS-50 capacity may be sent through the flush discharge connection. As part of shutdown, the system shall automatically conduct the membrane back flush cleaning cycle specified herein.

3.6.6.2 Controller. The OWMS-50 control system shall automatically adjust the appropriate subsystems to maintain system operation and performance as specified herein and prevent system damage. The controller shall incorporate a programmable logic controller (PLC). Each module shall have removable terminal strips to allow PLC component replacement without disconnecting wiring. The control system shall incorporate a system control switch (OFF, AUTO and CLEAN), main power disconnect switch, emergency stop, and elapsed time meter for system pumps. The controller shall incorporate a message display unit that provides visible display of system status and has keypad pushbuttons to allow operator access to modes and conditions. The controller shall have the following additional control modes and features accessed through the message display unit:

- a. Calibration mode that allows the user to monitor all sensors sequentially while adjustments is made.
- b. Operator checks mode providing means of jogging pumps and valves.
- c. Lamp and alarm test.
- d. Totalized values reset.
- e. Membrane integrity test mode.
- f. Manual password protected mode.

3.6.6.3 Warning indicators. A visual warning indicator shall be activated when the filtration module set is no longer capable of processing at least 35 gpm indicating the membrane modules will soon require cleaning or replacement.

3.6.6.4 Alarms. Audible and visual alarms shall automatically activate and shut down the system when a shutdown condition occurs. All alarms shall be of the latching variety with reset. A method to silence the alarms shall be installed. All alarms shall employ procedures to prevent inadvertent or nuisance alarms during transient operations (i.e., system start-up, shutdown, etc.) or from transient conditions (i.e., electrical spikes or pulses, electronic noise, sea conditions, etc.). The OWMS-50 shall not be damaged nor shall subsequent operational performance be degraded as a result of any alarm condition. The following conditions shall activate an alarm indicator:

- a. Membrane influent pressure outside the the upper or lower design operating range as specified in MIL-PRF-32097.
- b. Temperature of the fluid in the cross flow recirculation loop exceeds the membrane filtration system's maximum allowable temperature specified in MIL-PRF-32097.
- c. The filtration module set is no longer capable of processing at least 25 gpm (membrane modules require cleaning or replacement.)
- d. The OWMS-50 no longer maintains a 100-to-1 volume reduction factor.
- e. Any sensor is not ON or is inoperative.
- f. An overload trip has been activated.
- g. The feed system has failed.
- h. Improper valve actuation or pump failure.
- i. Membrane face plugging or a recirculation loop blockage (i.e., membrane hydraulic resistance range is outside the operational range specified in MIL-PRF-32097).
- j. The boundary between the concentrate and permeate has been compromised.
- k. Air pressure too low for proper operation (if ship provided compressed air is used.)
- l. Loss of AC power to system or DC power in control circuitry.

3.6.6.5 Indicator panel. The OWMS-50 shall display current status of the system locally and remotely. Local display shall be via a message display unit installed on the OWMS-50 unit and remote display shall be via the ship's ICAS. The message display indicators shall be in English standard units.

- a. The following status conditions and operating parameters shall be displayed locally and remotely at all times:
 - (1) System status (running, operational cleaning, hot cleaning, alarm and warning conditions).
 - (2) Flow rate of permeate delivered by OWMS-50.
- b. The OWMS-50 shall be capable of displaying the following status conditions and operating parameters locally:
 - (1) Date and time (year, month, day, hour, and minute).
 - (2) Pressure of the fluid in the cross flow recirculation loop.
 - (3) Trans membrane pressure (see 6.7.14) across the filtration modules.
 - (4) Pressure of the permeate discharged by the membrane modules.
 - (5) Temperature of the fluid in the cross flow recirculation loop.
 - (6) Total gallons of permeate delivered by OWMS-50. Totalizers shall be capable of being reset upon membrane change-out.

- (7) Total gallons of concentrate delivered by OWMS-50. Totalizers shall be capable of being reset upon membrane change-out.
- (8) Operating hours of each system pump.

3.6.6.6 Data logging. The OWMS-50 control system shall monitor and save values of the status conditions and operating parameters defined below and allow retrieval of this information. The control system shall be capable of saving data sets at 1 hour intervals for a period of 200 hours of operation before data retrieval is required. Retrieval of this data shall be provided via cable from the control system PLC to an external personal computer (PC). Data shall be a format compatible with text file reduction software including Microsoft Excel. Data logging and retrieval shall be provided for the following conditions and parameters:

- a. Date and time (year, month, day, hour, and minute).
- b. System status (running, operational cleaning, hot cleaning, alarm and warning conditions).
- c. Trans membrane pressure across the filtration modules.
- d. Pressure of the fluid in the cross flow recirculation loop.
- e. Pressure and flow rate of permeate delivered by OWMS-50.
- f. Temperature of the fluid in the cross flow recirculation loop.
- g. Total gallons of permeate delivered by OWMS-50. Totalizers shall be capable of being reset upon membrane change-out.
- h. Total gallons of concentrate delivered by OWMS-50. Totalizers shall be capable of being reset upon membrane change-out.
- i. Concentrate/permeate seal integrity at least 20-second intervals (continuous monitoring is acceptable).

3.6.6.7 Sensors and instruments. Sensors used in the OWMS-50 shall have minimum $\pm 0.5\%$ accuracy for the system's design operational range. Sensors shall be capable of calibration adjustments and allow replacement without unwiring. A method shall be provided to prevent connectors from being misconnected.

3.7 Interface requirements.

3.7.1 External (ship) interfaces.

3.7.1.1 Functional interface. The OWMS-50's functional interfaces with ship systems shall be compatible with the shipboard electrical, data, hydraulic, and pneumatic functional interfaces defined in Table I.

TABLE I. Shipboard interface requirements.

OWMS-50 Interface	Ship Interface (ship side of the interface)
Ship's OWS Effluent Supply	<p>System: Oily Waste System, including OWS</p> <p>Connection: 2.5-inch NPS with flange connection in accordance with (IAW) ASTM F1155 or MIL-STD-777 (see 6.2).</p> <p>Typical supply characteristics:</p> <p>Flow range: 0 to 60 gpm</p> <p>Positive head pressure: 22 psi</p> <p>Particulate contaminant: Max. 0.125 inch</p> <p>Oil concentration: 15 to 1500 ppm (Approx. avg. 150 ppm)</p> <p>Total suspended solids: 10 to 100 ppm</p> <p>Temperature: 30 °F to 120 °F</p> <p>pH range: 4 to 8</p> <p>Maximum back pressure allowable to OWS is –3 to 22 psig.</p>
Permeate Discharge	<p>System: Overboard Discharge System</p> <p>Connection: 2.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).</p>
Concentrate Discharge	<p>System: Waste Oil System, including WOT</p> <p>Connection: 1.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).</p>
Flushing Water Discharge	<p>System: Oily Waste System, including oily waste holding tank (OWHT) (see 6.7.9)</p> <p>Connection: 2.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).</p>
Potable Water Supply	<p>System: Potable Water System</p> <p>Connection: 0.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).</p> <p>Supply characteristics:</p> <p>Pressure: Max. 100 psig, Min. 50 psig</p> <p>Temperature: 35 °F to 90 °F</p> <p>Bromine or chlorine residual: 0.2 mg/L</p>
Compressed Air Supply	<p>System: Compressed Air Service System</p> <p>Connection: 0.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).</p> <p>Supply characteristics:</p> <p>Pressure: Max. 120 psig at 20 scfm Min. 100 psig at 5 scfm</p> <p>Temperature: Max. 55 °F</p> <p>Water content: Max. 25% liquid water</p> <p>Hydrocarbon contaminant: Max. 50 ppm by weight</p> <p>Particulate contaminant: Max. 5 microns</p>

TABLE I. Shipboard interface requirements – continued.

OWMS-50 Interface	Ship Interface (ship side of the interface)
Electrical Power Supply	<p>System: Electrical Power Distribution System</p> <p>Connection: see 6.2.</p> <p>Supply characteristics: IAW MIL-STD-1399, Section 300, Type I Power (440/115 Vac, 60 Hz, 3 phase)</p> <p>Note: Electrical power as defined in MIL-STD-1399, Section 300, is significantly different from commercial standards. Some supply characteristics, such as fault currents, harmonic current limits, and voltage variations, are more severe than those seen in a commercial environment.</p>
Data Exchange(Remote Monitoring)	<p>System: Integrated Condition Assessment System (ICAS)</p> <p>Connection: see 6.2.</p> <p>Functional: IAW IEEE 45, IEEE 1451.2, IEEE 1284, and MIL-STD-1553 (see 6.2).</p>

3.7.1.2 Physical interface. The OWMS-50's interfacing pipe connections shall be compatible with the mating shipboard interface connection defined in Table I. The OWMS-50 shall be skid-mounted with interfacing structural mounts capable of attachment to a steel deck without deforming or damaging the ship's deck.

3.7.2 Internal (filtration module) interfaces.

3.7.2.1 Functional interface. The OWMS-50 recirculation subsystem shall maintain a maximum pressure of 100 psi or less, and ensure each filtration module operates within the performance requirements specified in MIL-PRF-32097. Permeate flow from each filtration module shall be controlled by the OWMS-50 permeate discharge subsystem to be less than 3.7 gpm. The OWMS-50 shall support all filtration module requirements specified in MIL-PRF-32097.

3.7.2.2 Physical interface. The physical interface between the filtration module and the OWMS-50 recirculation and permeate subsystems shall be as defined in NAVSEA DWG 803-6983497. In addition, the interface between the filtration module permeate discharge connection and the permeate discharge subsystem shall be a flexible connection. All flexible permeate connections for the individual filtration modules shall connect to a rigid manifold.

3.8 Hydrostatic integrity. The OWMS-50 shall withstand hydrostatic pressure 1.5 times the filtration module's maximum design pressure specified in MIL-PRF-32097 for a period not less than 30 minutes. When pressure is applied and maintained for the specified period, the OWMS-50 shall show no sign of leakage, material deformation or rupture, or other defects that harmfully affect the performance and serviceability of the OWMS-50.

3.9 Reliability and maintainability.

3.9.1 MTBCF. The Mean Time Between Critical Failure (MTBCF) (see 6.7.7) of the system shall be at least 400 hours when the system is operated at rated capacity.

3.9.2 Maintenance ratio. The OWMS-50 shall have a maintenance ratio (see 6.7.6) of not greater than 0.03. The maintenance ratio is the ratio of total active maintenance man-hours (scheduled and unscheduled) to the total operating time. The time required to perform any preventive maintenance (see

6.7.12) action should be not greater than two man-hours by an Engineman third class or Electrician's Mate third class with no formal equipment training.

3.9.3 Maintenance access. All major OWMS-50 assemblies and installed attachments shall be accessible for maintenance, repair, and replacement without the removal of other major assemblies and installed attachments not normally installed. All components shall be arranged so all maintenance can be performed with access from only the front of the system and one adjacent side.

3.9.4 Maintenance clearance. The clearance required for equipment removal and maintenance shall extend no further than 24 inches in the horizontal plane away from the unit front and adjacent side designed for access, and shall not exceed 79 inches from the unit bottom in the upward vertical direction.

3.9.5 Filtration module maintenance. The OWMS-50 shall support the filtration system maintenance specified in MIL-PRF-32097.

3.10 Safety. The OWMS-50 shall present no uncontrolled hazards to operating or maintenance personnel. All electrical enclosures shall be NEMA 250 or equivalent.

3.11 Human factors. All man-to-machine interfaces (i.e., controls, displays, alarms, etc.) shall be suitable for user personnel with applicable fifth through ninety-fifth body dimensions as defined in ASTM F1166.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection. (see 4.1.1)
- b. Conformance inspection. (see 4.1.2)

4.1.1 First article inspection. The first article inspection shall be performed on a minimum of one complete OWMS-50 assembly. This inspection shall consist of the examination in 4.2 and the tests specified in Table II.

4.1.2 Conformance inspection. The conformance inspection shall be performed on all OWMS-50 assemblies and shall consist of the examination in 4.2 and the tests specified in Table II.

4.2 Examination. Each OWMS-50 shall be examined for compliance with the requirements of 3.5, 3.5.1 through 3.5.4, 3.5.7, 3.5.8, 3.6.4, 3.6.5, 3.7.1.2, 3.7.2.2, 3.9.3, and 3.9.4. This element of inspection shall encompass all visual examinations including verification of physical interfaces, operational parameters and capabilities, system design compliance, and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects shall constitute cause for rejection.

4.3 Tests.

4.3.1 Material test. Conformance to 3.2 shall be determined by inspection of contractor records providing proof or certification that materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

TABLE II. Requirements and verification methods.

Requirement Title	Requirement Paragraph	1 st Article Test Method	Conformance Test Method
Materials	3.2	4.3.1	N/A
Wetted materials	3.2.1	4.3.1	N/A
Dissimilar metals	3.2.2	4.3.1	N/A
Material deterioration, prevention and control.	3.2.3	4.3.1	N/A
Identification of materials and finishes	3.2.4	4.3.1	N/A
Electrical cable materials	3.2.5	4.3.1	N/A
Environmental considerations	3.4	4.3.2	N/A
Shock	3.4.1	4.3.2.1	N/A
Environmental vibration	3.4.2	4.3.2.2	N/A
Internally excited vibration	3.4.3	4.3.2.3	N/A
Airborne noise	3.4.4	4.3.2.4	N/A
Structureborne noise	3.4.5	4.3.2.5	N/A
Electromagnetic compatibility	3.4.6	4.3.2.6	N/A
Operational temperatures	3.4.7	4.3.2.7, 4.2.2.8	N/A
Storage (non-operating) temperatures	3.4.8	4.3.2.7, 4.3.2.8	N/A
Humidity	3.4.9	4.3.2.9	N/A
Inclination	3.4.10	4.3.2.10	N/A
Salt fog	3.4.11	4.3.2.11	N/A
Design	3.5	4.2	4.2
Feed system	3.5.1	4.2	4.2
Separation system	3.5.2	4.2	4.2
System connections	3.5.3	4.2	4.2
Size and weight	3.5.4	4.2, 4.3.1	4.2
Power consumption	3.5.5	4.3.4	4.3.5
Compressed air consumption	3.5.6	4.3.4	4.3.5
Grounding and bonding	3.5.7	4.2	4.2
Markings	3.5.8	4.2	4.2
Performance characteristics	3.6	4.3.4	4.3.5
Permeate discharge requirements	3.6.1	N/A	N/A
Permeate discharge flow	3.6.1.1	4.3.6	4.3.5
Oil removal	3.6.1.2	4.3.4	4.3.5
Concentrate discharge requirements	3.6.2	N/A	N/A
Concentrate discharge flow	3.6.2.1	4.3.6	4.3.5
Particulate removal	3.6.2.2	4.3.4	N/A

TABLE II. Requirements and verification methods – continued.

Requirement Title	Requirement Para.	1 st Article Test Method	Conformance Test Method
Flushing water discharge requirements	3.6.3	N/A	N/A
Flushing water discharge flow	3.6.3.1	4.3.6	4.3.5
Self-cleaning cycles	3.6.3.2	N/A	N/A
Membrane back flush cleaning cycle	3.6.3.2.1	4.3.4	4.3.5
Membrane hot flush cleaning cycle	3.6.3.2.2	4.3.4	4.3.5
System drain	3.6.3.3	4.3.4	N/A
Back flow prevention	3.6.4	4.2	4.2
Compressed air water removal	3.6.5	4.2	4.2
Operation and controls	3.6.6	4.3.6	4.3.6
Normal operation	3.6.6.1	4.3.4, 4.3.6	4.3.6
Controlling	3.6.6.2	4.3.6	4.3.6
Warning indicators	3.6.6.3	4.3.6	4.3.6
Alarms	3.6.6.4	4.3.6	4.3.6
Indicator panel	3.6.6.5	4.3.6	4.3.6
Data logging	3.6.6.6	4.3.6	4.3.6
Sensors and instruments	3.6.6.7	4.3.6	4.3.6
Interface requirements	3.7	N/A	N/A
External (ship) interfaces	3.7.1	N/A	N/A
Functional interfaces	3.7.1.1	4.3.6	4.3.5, 4.3.6
Physical interfaces	3.7.1.2	4.2	4.2
Internal (filtration module) Interfaces	3.7.2	N/A	N/A
Functional interface	3.7.2.1	4.3.6	4.3.5, 4.3.6
Physical interface	3.7.2.2	4.2	4.2
Hydrostatic integrity	3.8	4.3.3	4.3.3
Reliability and maintainability	3.9	N/A	N/A
MTBCF	3.9.1	4.3.7	N/A
Maintenance ratio	3.9.2	4.3.8	N/A
Maintenance access	3.9.3	4.2	4.2
Maintenance clearance	3.9.4	4.2	4.2
Filtration module maintenance	3.9.5	4.3.4	4.3.5
Safety	3.10	4.3.9	4.3.9
Human factors	3.11	4.3.10	N/A

4.3.2 Environmental verification tests.

4.3.2.1 Shock test. The OWMS-50 shall be shock tested as a complete assembly (including the heaviest filtration modules allowed in MIL-PRF-32097, valves, strainers, tanks, pumps/motors, inter-connecting piping, etc.) in accordance with MIL-S-901 as specified in 3.4.1. Since this test is often destructive, use of a nonfunctional membrane/housing is allowable.

4.3.2.2 Environmental vibration. The OWMS-50 shall be tested in accordance with MIL-STD-167/1 as specified in 3.4.2.

4.3.2.3 Internally excited vibration. The OWMS-50 shall be tested in accordance with MIL-STD-167/1 as specified in 3.4.3.

4.3.2.4 Airborne noise. The OWMS-50 shall be tested for airborne noise in accordance with MIL-STD-740/1 as specified in 3.4.4.

4.3.2.5 Structureborne noise. The OWMS-50 shall be tested for structureborne noise tests in accordance with MIL-STD-740/2 as specified in 3.4.5.

4.3.2.6 Electromagnetic compatibility. The OWMS-50 shall be tested as specified in 3.4.6 to determine conformance with the applicable electromagnetic emissions and susceptibility requirements in MIL-STD-461.

4.3.2.7 High temperature. The OWMS-50 shall be tested for high temperature storage and operation in accordance with MIL-STD-810, method 501.4, procedure I and II. The maximum test temperature for operating shall be the upper limit specified in 3.4.7. The maximum test temperature for the storage temperature shall be the upper limit specified in 3.4.8. The operating period for each test shall be one hour at the constant maximum temperature.

4.3.2.8 Low temperature. The OWMS-50 shall be tested for low temperature storage and operation in accordance with MIL-STD-810, method 502.4, procedure I and II. The lowest test temperature for operating shall be the lower limit specified in 3.4.7. The lowest test temperature for the storage temperature shall be lower limit specified in 3.4.8. The operating period for each test shall be one hour at the constant minimum temperature.

4.3.2.9 Humidity. The OWMS-50 shall be tested for the effects of a warm humid environment in accordance with MIL-STD-810, method 507.4.

4.3.2.10 Inclination. The OWMS-50 shall be subjected to the inclination test specified in 3.4.10. This test shall be repeated with the OWMS-50 rotated 90 degrees through the vertical to the plane in which it was originally tested.

4.3.2.11 Salt fog. The OWMS-50 shall be tested for corrosion, electrical and physical effects of aqueous salt atmosphere accordance with MIL-STD-810, method 509.2. Duration of test shall be 48 hours exposure followed by a 48-hour drying time.

4.3.3 Hydrostatic pressure test. All pressurized portions of the OWMS-50 shall be subjected to a hydrostatic pressure test as specified in 3.8 using potable water supplied at temperatures between 120 °F and 130 °F for first article, and between 65 °F and 75 °F for production units. The test shall be performed with the filtration modules installed and a connection made between the permeate connection for each filtration module and the recirculation loop to preclude the development of excessive and potentially damaging trans-membrane pressure. In addition, all remaining shipboard interfaces, air relief valves, and

potable water supply valves shall be secured. After the test, the system shall be drained and allowed to air dry

4.3.4 Operational test (first article). This test shall demonstrate that the first article OWMS-50, with the functioning filtration modules installed, meets the processing capabilities and operational modes specified herein. The following shall be performed:

- a. Operate the system for 100 runs at 3 hours per run for a total of 300 hours of operation. The OWMS-50 shall remain OFF for at least 1 hour between operating cycles.
- b. The system shall process 50 gpm of oily waste influent containing 100-ppm Navy oil mix #4 and 25-ppm Navy detergent mix, as defined in 4.3.4.1, in potable water connected at the ship's OWS effluent supply interface, at a volume reduction factor of 100 to 1 for 300 hours. On every 5th test run, a sufficient load of solids, as defined in 4.3.4.1, shall be added to the feed stream to demonstrate the particulates in the OWMS-50 influent are removed and purged as specified in 3.6.2.2. During each 3-hour test run, the feed stream to the OWMS-50 shall be secured for 3 to 10 minutes, at randomly selected times, to simulate OWS effluent behavior. Samples shall be collected and analyzed during each 3-hour test run in accordance with 4.3.4.2 to verify the oil removal capabilities in 3.6.1.2.
- c. Verify the system performs an automatic membrane back flushing cleaning mode as specified in 3.6.3.2.1 at the end of each run (as a result of a predetermined time set when feed inflow is zero) and after the system goes into shutdown mode. The test setup shall have a meter installed at the potable water supply connection to verify consumption of water does not exceed that specified in 3.6.3.2.1.
- d. Perform a 6-hour membrane hot flush cleaning after completing 100 and 200 hours of operation to demonstrate the self-cleaning capabilities specified in 3.6.3.2.2. No more than three hot flush procedures shall be performed during the operational test. The test setup shall have a meter installed at the potable water supply connection to verify consumption of water does not exceed that specified in 3.6.3.2.2.
- e. If the system uses externally provided compressed air, the test setup shall have a meter installed at the air supply connection to verify the amount of compressed air consumed by OWMS-50 after twenty-four hours of operation does not exceed that specified in 3.5.6.
- f. Power consumption shall be measured on a periodic basis during the testing to verify consumption rates do not exceed that specified in 3.5.5.
- g. Upon completion of all test runs, the system shall be drained through the flushing water discharge interface connection to verify the drain capabilities specified in 3.6.3.3. The filtration modules shall be removed and replaced.

4.3.4.1 Test mixture. The test mixture shall be fed into the system in such a way as to ensure complete mixing is reached. The solids mixture below shall only be included in the test mixture on every 5th test run. The test mixture is defined as follows:

- a. Navy oil mix #4 consists of (by percent weight)
 - (1) MIL-PRF-16884, 50 percent
 - (2) MIL-PRF-17331, 25 percent

- (3) MIL-PRF-9000, 25 percent
- b. Navy detergent mix #4 consists of (by percent weight)
 - (1) MIL-D-16791 (Type I), 50 percent
 - (2) Commercial liquid detergent, 25 percent
 - (3) MIL-PRF-680 (Type III), 25 percent
- c. Solids mixture
 - (1) Minimum particle size is 0.008 inch by 0.125 inch
 - (2) Specific gravity is greater than 1

4.3.4.2 Oil sampling. A minimum of 50 permeate samples and 10 feed samples shall be obtained at random times throughout the test. The samples shall be collected and analyzed in accordance with EPA Method 1664. A minimum of 3 quality control (QC) standard samples containing 10-ppm Navy oil mix #4 and 3 QC standards containing 100-ppm Navy oil mix #4, prepared by an independent laboratory, shall be inserted randomly into the analysis matrix to evaluate the analysis laboratory's accuracy. The performance test shall not be accepted if the actual mean feed oil content is 60 ppm or less.

4.3.5 Operational test (production units). The OWMS-50 shall be operated at rated flow and pressure for 2 hours to demonstrate system operates within operating parameters specified 3.6 and safety requirements in 3.10.

4.3.6 Functional test. The OWMS-50 shall be operated under all interface conditions for a period of not less than 1 hour to verify the control system's functional operation in 3.6.6 and all subparagraphs, permeate discharge flow capability in 3.6.1.1, concentrate discharge flow capability in 3.6.2.1, and flushing water discharge flow capability in 3.6.3.1, ship functional interface requirements in 3.7.1.1, and filtration module functional interface requirements in 3.7.2.1. All warning and alarm conditions described herein shall be simulated to verify all OWMS-50 warning indicators, alarms and data logging capabilities function correctly. All sensors and instruments shall be supplied a source to verify sensor calibration and displayed value on the system's message display unit.

4.3.7 MTBCF. The operational test in 4.3.4 shall demonstrate the OWMS-50 complies with the MTBCF requirement in 3.9.1.

4.3.8 Maintenance ratio. The scheduled and unscheduled maintenance shall be timed, accumulated and converted to a maintenance ratio during first article testing to verify compliance with the requirement in 3.9.3. Only scheduled maintenance in the manufacturers recommended maintenance schedule shall be permitted.

4.3.9 Safety. The OWMS-50 shall be evaluated throughout testing for safety requirements in 3.10.

4.3.10 Human factors. The OWMS-50 shall be inspected and evaluated throughout testing for human factor requirements in 3.11.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel,

these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature, which may be helpful, but is not mandatory.)

6.1 Intended use. The OWMS-50 described in this specification is intended for use onboard Naval ships to process effluent from an OWS, to consistently produce an effluent containing no greater than 15-ppm oil content. The overall intended service life of the OWMS-50 is 30 years minimum with an operating life expectancy of 40,000 hours minimum.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1)
- c. Packaging requirements (see 5.1).
- d. Ship or class of ship, or specific application for which the OWMS-50 is intended, interface location specifications, interface connection specifications, electromagnetic emissions and susceptibility requirements, and ICAS interface specifications.
- e. When first article is required (see 3.1).
- f. Material certificates (see 4.3.1).

6.3 System requirements. Additional information regarding the Navy studies in the field of ultrafiltration may be found on the Internet. Website URLs will be provided by the procuring activity upon request. Developmental information originates from Naval Surface Warfare Center, Code 634, Bethesda, MD. The system incorporates an open system architecture (OSA) strategy as defined in 6.7.10.

6.3.1 Recommended test material. Test conducted at Naval Surface Warfare Center used Liquid Tide™ as the commercial laundry detergent.

6.3.2 Recommended filtration module configuration. The recommended configuration of the filtration modules within the OWMS-50 is shown in Figure 1. The principle feature of this configuration is the combination of series and parallel alignment of the membrane modules to provide maximum retention time.

6.3.3 Recommended water heating method. Heating of the ship provided potable water during a membrane hot flush is recommended to be entirely by the action of the recirculation pump.

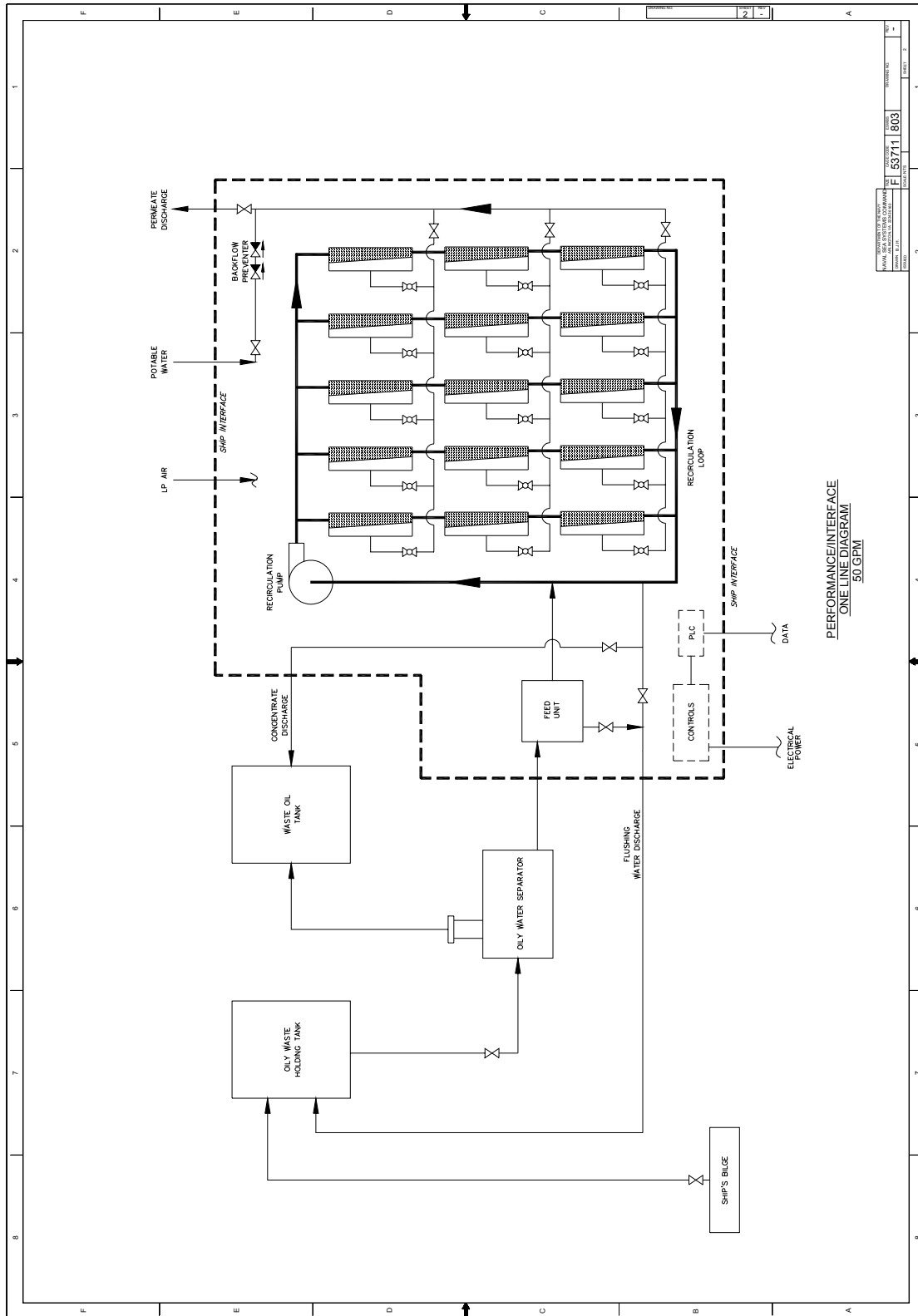


FIGURE 1. OWMS-50 prototype system design.

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, specifications and standards that have been cleared and listed in DoD 5010.12, Acquisition Management Systems, and Data Requirements Control List (AMSDL) will be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals will be acquired under separate contract line item in the contract.

6.5 Design and fabrication guidelines. The component design guidelines provided in this section are based upon past Navy shipboard experience with the OWMS. Oily waste membrane systems designed under those guidelines, have successfully met the performance requirements specified herein. These guidelines are intended to assist the contractor in ensuring that the OWMS-50 fully meets those performance requirements. Any deviation from the guidelines provided in this section may be taken under consideration by the procuring activity. However, any such deviation should be fully justified by the vendor and should be based upon submission of specific calculations and OWMS-50 operating and performance data that have been taken under similar environmental conditions (including noise, shock, vibration, and EMI where applicable) with total operating times as those given in the follow-on paragraphs.

6.6 Oil/water separator (OWS) effluent behavior characteristics. Supply to the OWMS-50 comes from the C-50 OWS. The OWS has one inlet (bilge water) and two outlets (light phase/oil and heavy phase/water). The OWS inlet is a continuous feed, with its discharge cycling between the light phase and heavy phase. The effluent frequency is unpredictable. When the effluent is flowing from the C-50 OWS, the flow rate can vary from 0 to 60 gpm. Typical feed characteristics to the oily waste membrane system are described in 4.3.4. Additionally, numerous contaminants are found in bilge water. Constituents of the contaminants would most likely be, but not limited to, the chemicals identified in Phase I of Uniform National Discharge Standards (UNDS) project plus seawater.

6.7 Definitions.

6.7.1 Concentrate. Contaminant-laden fluid that has not passed through the membrane as permeate, also known as retentate.

6.7.2 Corrective maintenance. All actions performed as a result of failure to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: localization, isolation, disassembly, interchange, re-assembly, alignment, and checkout.

6.7.3 Critical failure. For testing purposes, a critical failure is defined as any fault, failure or malfunction which causes or may cause:

- a. Failure to commence operation, cessation of operation or degradation of performance below specified levels.
- b. Damage to the OWMS by continued operation.
- c. Safety hazard to personnel.

6.7.4 Effluent. Clean water output from either the OWS or the oily waste membrane system. May be used interchangeably with permeate to describe clean water produced by the oily waste membrane system.

6.7.5 Feed. The influent stream to be processed by the oily waste membrane system.

6.7.6 Maintenance ratio. A maintenance ratio is a measure of the total maintenance manpower burden required to maintain an item. It is expressed as a ratio of the total active maintenance man-hours (scheduled and unscheduled) to the total operating time.

6.7.7 Mean time between critical failure (MTBCF). The total amount of mission time divided by the total number of critical failures (see 6.7.3) during a stated series of missions.

6.7.8 Oil/water separator (OWS). Generally used to refer to any device that separates oil and water. The OWS processes oily waste before the oily waste membrane system.

6.7.9 Oily waste holding tank (OWHT). The OWHT receives oily waste from the ship's bilges. It serves as a settling tank and as the source from which the OWS draws influent.

6.7.10 Open system architecture (OSA). The resulting open system design should optimize predicted life cycle cost and performance, allow advances in technology to be readily incorporated, and provide for rapid reconfiguration of systems to respond to mission or operational requirement changes. The open system design should favor modularity and compatibility with other Fleet assets and should use standard and/or publicly available, nonproprietary interfaces such that new or upgraded functionality can be incorporated from multiple suppliers over the ship's life cycle. The open system design should facilitate operations in combined missions with other services and interagency, multi-national, and non-Government organizations.

6.7.11 Permeate. Clean fluid obtained by membrane filtration.

6.7.12 Preventive maintenance. All actions performed in an attempt to retain an item in specified condition by providing systematic inspection, detection, and prevention of incipient failures.

6.7.13 Subsystem. A subsystem is a system within one of the defined systems.

6.7.14 Trans membrane pressure. Trans membrane pressure is the differential pressure between the filtration module's average concentrate pressure and permeate pressure.

6.7.15 Volume reduction factor. Volume reduction factor is the amount of membrane system influent compared to the amount of concentrate discharged (i.e., 100:1 equals 1 gallon of concentrate for 100 gallons of influent).

6.7.16 Waste oil tank (WOT). The WOT receives oily waste and bulk oil from the OWS and OWMS-50 for later disposal ashore.

6.8 Subject term (key word) listing.

- a. Bilge water
- d. Filtration
- e. Membrane
- f. Membrane module
- g. Oil pollution abatement
- h. Oil/water separator
- i. Oily waste holding tank

- j. Open system architecture
- k. OSA
- l. OWHT
- m. OWS
- b. Ultrafiltration
- n. Waste oil tank
- o. WOT

Custodians:

Army - AT
Navy - SH
Air Force - 99

Preparing activity:

Navy - SH
(Project 4610-0031)

Review activities:

Army – GL, GL4
Navy – YD
Air Force – 03, 84
DLA – CC
CIV – 7FLE